5. Near-Shore Acoustical Survey Near Cape Shirreff, Livingston Island; submitted by David A. Demer (Leg I) and Adam Jenkins (Leg I).

5.1 Objectives: The principal aim was to survey the near-shore-prey and habitat within the foraging ranges of seals and penguins that were concurrently monitored via satellite tags at Cape Shirreff. The area covered with this multidisciplinary study is too close to shore to be safely surveyed with R/V *Yuzhmorgeologiya*. A small-craft was purpose-built for this study. The data describes the prey-field within the immediate vicinity of land-breeding predators and allows exploration of the physical oceanographic, bathymetric, and meteorological conditions that may influence the variability in the neritic dispersion and abundance of the prey.

5.2 Accomplishments: A near-shore survey (out to about 10 nautical miles off Cape Shirreff) was conducted using a specially equipped 19-foot Zodiac; meanwhile, a complimentary offshore survey (out to 60 n.mi.) was conduct via *Yuzhmorgeologiya*. The Zodiac, R/V *Ernest* (Figure 5.1), was launched from the ship on 5 February. Subsequent day-to-day operations were based from the island camp. *Ernest* was used to conduct acoustical transects, deploy a CTD at selected stations, and lower an underwater video camera into acoustic targets for the purpose of species identification. The ship operated further offshore (Figure 5.3), but in such a manner so as to be ready to render assistance by picking up the survey Zodiac and/or launching a second Zodiac, which was held ready as a rescue boat. The ship concurrently conducted acoustic transects and CTD and IKMT net sampling stations following the procedures outlined for the CCAMLR 2000 Synoptic Survey. Ship operations were on a 24-hour per day basis, while Zodiac operations were conducted for approximately 6 to 9 hours each day.

To enable the multidisciplinary survey in relatively shallow waters, the 19-foot Zodiac *Mark V* was fitted with a custom aluminum house with remote steering station and wind-break; two engines (9.9 HP 4-stoke Yamaha and 45 HP Evinrude); Simrad EY500 split-beam 120kHz echosounder with control/data logging computer; motorized down-rigger for deployment of an SBE19 SeaCat CTD and a digital 3-CCD underwater video and lighting system; redundant GPS's for measuring date, time, latitude, longitude, quality, number of satellites, HDOPS, course over ground, and speed over ground, redundant VHF radios; a WeatherPak 2000 meteorological station for measuring bearing, apparent and true wind speed and direction, barometric pressure, humidity, and air temperature; a Raytheon 24 n.mi. radar; NOAA's Scientific Computer System for continuous data logging and display; four gel cell batteries for up to 20 hours of continuous survey operations; an alternator and backup generator for power restoration; compass; binoculars; survival equipment including a 406MHz EPIRB, and a camping and survival-kit.

5.3 Results and Tentative Conclusions: Volume backscattering strengths (120kHz) were integrated over 250m depths and averaged over 0.1 n.mi. trackline distances (Sa). These values are considered proportional to the densities of krill (Figure 5.2). Underwater video observations verified that the acoustic targets were large *Euphausia superba*. A 6 n.mi. long cluster of krill swarms was mapped immediately to the east of the cape; other large swarms were observed between 5 and 10 n.mi. offshore. During the survey, fur seals and penguins were frequently seen in each of the areas with high krill densities.

Due to slower than expected boat speed, every other line of the planned track was surveyed with *Ernest* out to 10 n.mi. The *Yuzhmorgeologiya* filled the gap by surveying further inshore.

In-situ target strength measurements were considered between depths of 10 and 40m and off-axis angles of less than 3 degrees (Figure 5.4). Although the single-frequency TS distribution is likely biased high, the mode between -65 and -68dB is consistent with large krill (>50mm lengths) as suggested by the underwater video observations.

5.4 Disposition of Data: Data are available from David A. Demer, Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA 92037; phone/fax (858) 546-5603/5608; email: ddemer@ucsd.edu

5.5 Acknowledgements: We are indebted to Leif Knutsen of Port Townsend Shipwrights, Inc. for the design and construction of the custom aluminum house/steering station/electronics enclosure used in this survey. Leif's genius, craftsmanship, and dedication made this investigation possible. Dave Benigni and Dennis Shields of NOAA's Marine and Aviation Operations are also gratefully acknowledged for providing the SCS system.

Figure 5.1 R/V *Ernest* four-point moored off Cape Shirreff, Livingston Island, Antarctica. The red 120kHz split-beam transducer sits atop the retracted arm (port-side); the WeatherPak 2000 meteorological station, radome, and 406MHz EPIRB are mounted on the cabin top; and the motorized down-rigger used for deploying the CTD and underwater video system is positioned near the steering station (starboard side).

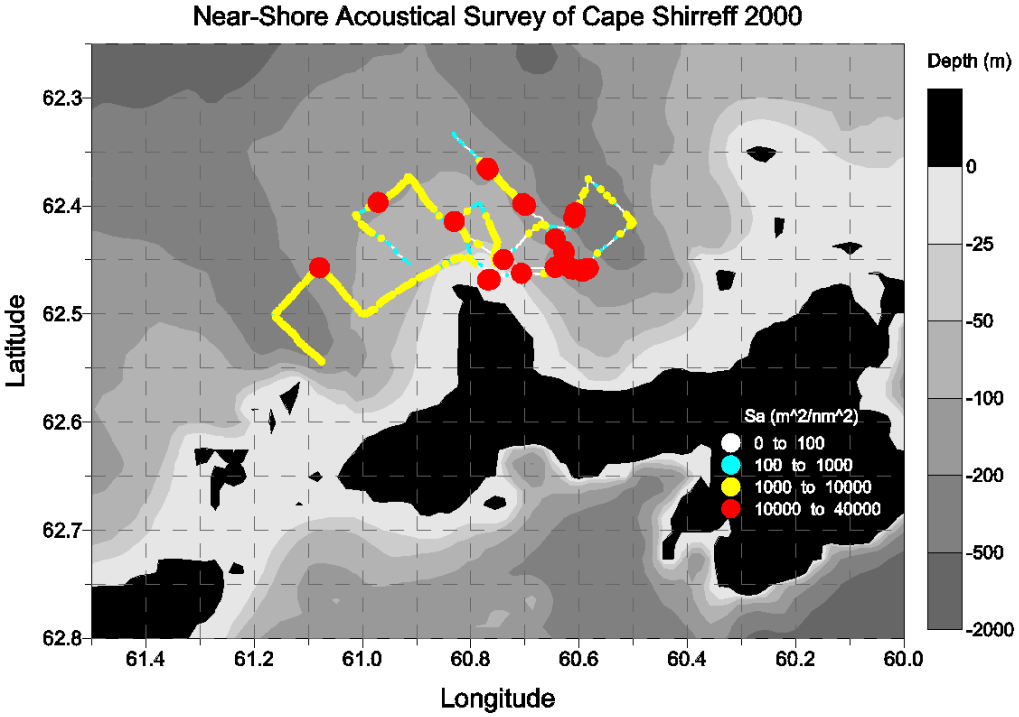

Figure 5.2 A 120kHz echosounder was used to survey Antarctic krill in the near-shore region of Cape Shirreff. Volume backscattering strengths integrated over 250m depth and averaged over 0.1 n.mi. trackline distances (Sa) are considered proportional to the densities of krill. Underwater video observations verified that the acoustic targets were large *Euphausia superba*. A 6 n.mi. long cluster of krill swarms was mapped immediately to the east of the

cape; other large swarms were observed between 5 and 10 n.mi. offshore. During the survey, fur seals and penguins were frequently seen in each of the areas with high krill densities.

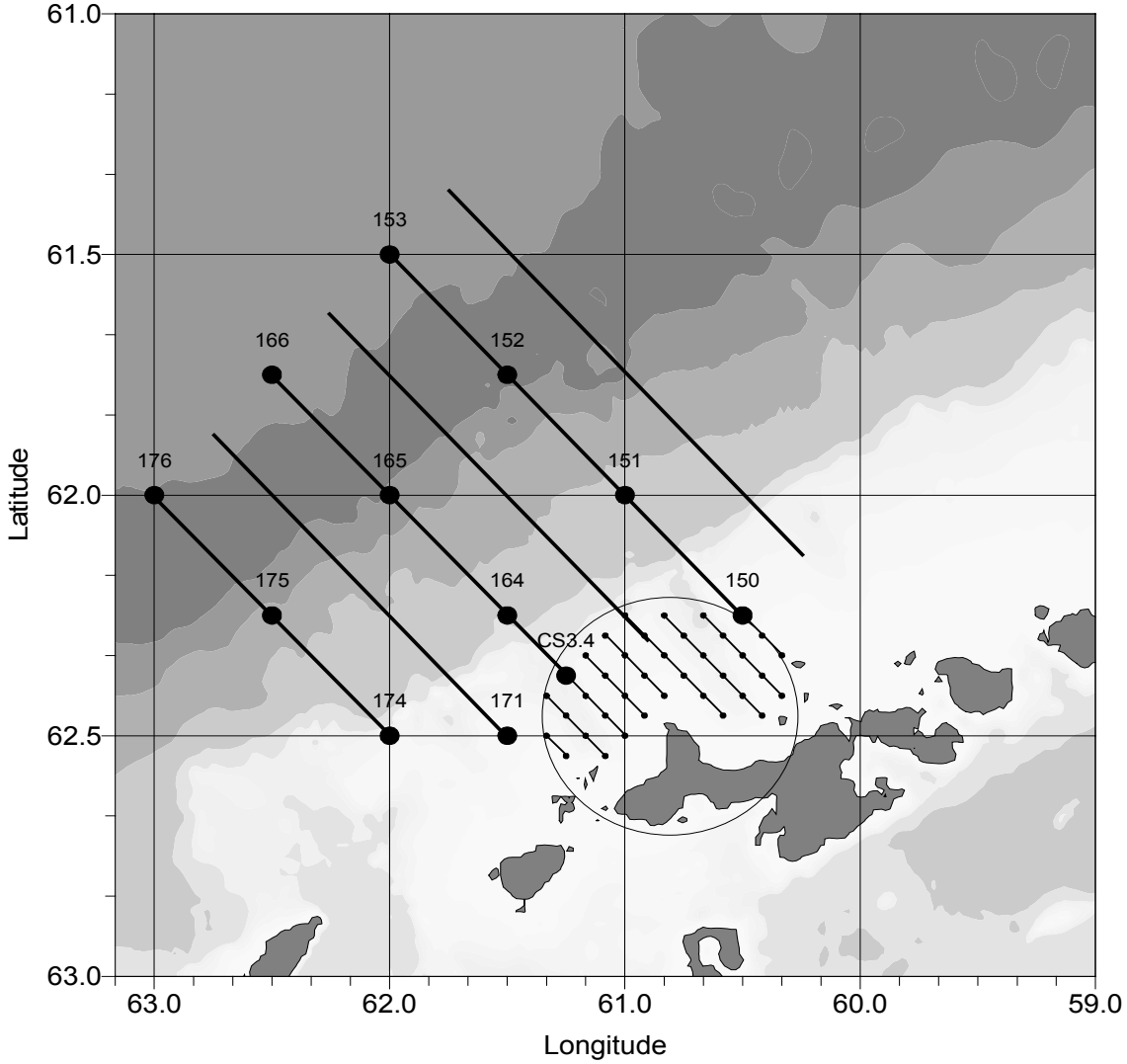

Figure 5.3 Planned Cape Shirreff survey. Thick lines and large dots indicate transects and stations for survey by the ship. Thin lines and small dots indicate transects and stations intended for survey by R/V *Ernest*. Stations D150 and CS3.4 were to be occupied by both the ship and the Zodiac. The circle indicates a 15 n.mi. radius from Cape Shirreff. Ultimately, every other line was surveyed with *Ernest* out to 10 n.mi. (see Figure 5.2) and *Yuzhmorgeologiya* filled the gap by surveying further inshore. Depth shading is 0-500m, 500-2000m, 2000-4000m and greater than 4000m.

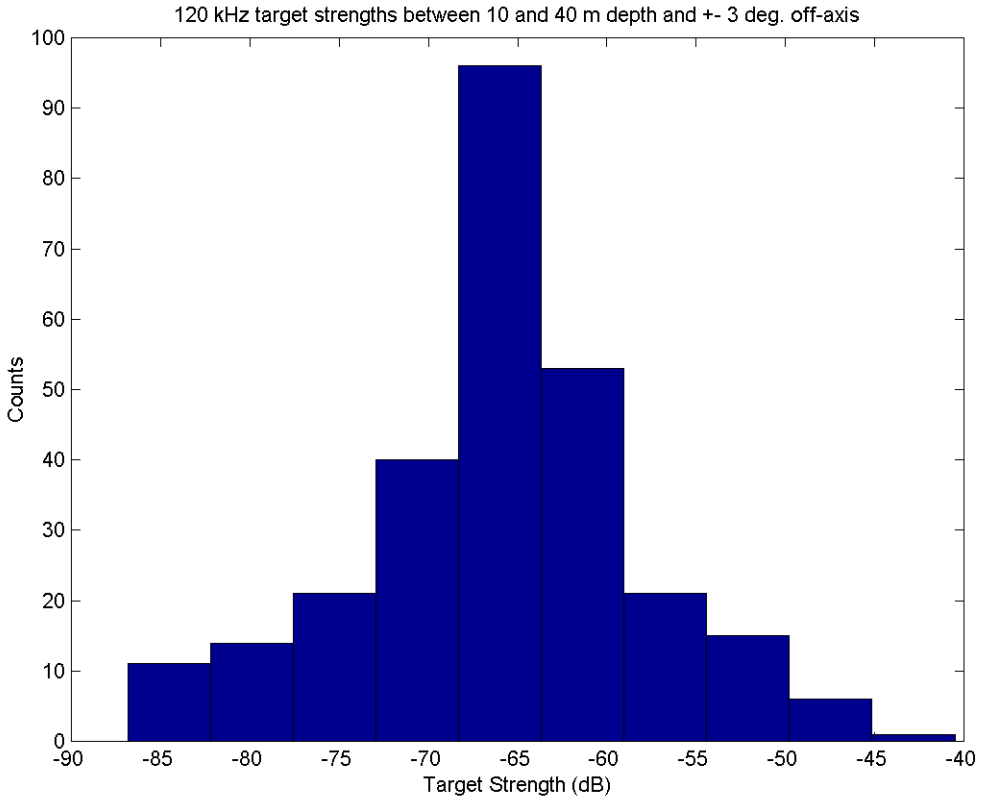

Figure 5.4 *In-situ* target strength measurements at 120kHz. Measurements were constrained to depths between 10 and 40m and off-axis angles of less than 3 degrees. The distribution is likely biased high, but the mode between -65 and -68dB is consistent with large krill (>50mm lengths) as suggested by the underwater video observations.